Iowa Annual Data Review 2012 – Manganese

Ambient Air Monitoring Group
Iowa Department of Natural Resources

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Summary

Iowa Department of Natural Resources (DNR) Manganese Monitoring

The DNR operates a manganese monitoring site near Griffin Pipe Products Facility in Council Bluffs (Appendix A. Council Bluffs Monitoring Locations). Griffin Pipe utilizes manganese in its pipe manufacturing process, and these emissions are large enough that Griffin Pipe is required to provide estimates of its air emissions of manganese to EPA's toxic release inventory (TRI). Utilizing TRI emissions estimates from industries across the nation, USA Today[1] used an EPA risk assessment tool to establish a list of schools across the nation with elevated risk due to air toxic emissions. This list of schools included schools near Griffin Pipe, and the excess risk at these schools was attributed to manganese emissions from Griffin Pipe. In the aftermath of the USA Today report, EPA utilized a long-term "non-cancer" reference concentration of 50 ng/m^3 to evaluate the results of manganese sampling it conducted. EPA indicated that monitoring sites that experienced levels above this threshold would be the focus of ongoing monitoring and the development of a mitigation strategy.[2] DNR began manganese monitoring near Griffin pipe in 2011. The site average during 2011 was 104 ±53 ng/m^3.[3] To reduce the uncertainty in the site average, the sampling frequency in 2012 was increased to one sample every third day. In this report, we determine that the 2012 annual average at the Griffin Pipe monitoring site was 95 ±16 ng/m^3, well above the reference concentration establish by EPA.

The DNR continues to work with Griffin Pipe to improve its manganese emissions estimates, including stack emissions, un-captured emissions (emissions that are released inside the building and vent through the roof) and fugitive emissions (emissions that arise from dust that falls near the facility and becomes airborne again in high winds). A more accurate characterization of the emissions from Griffin Pipe and other potential sources in the area will allow for the department to develop an effective mitigation strategy to reduce ambient manganese levels. Improvements in emission characterization at Griffin Pipe will also be needed to mitigate elevated lead levels recorded at the monitoring location.[4]

Additional Information

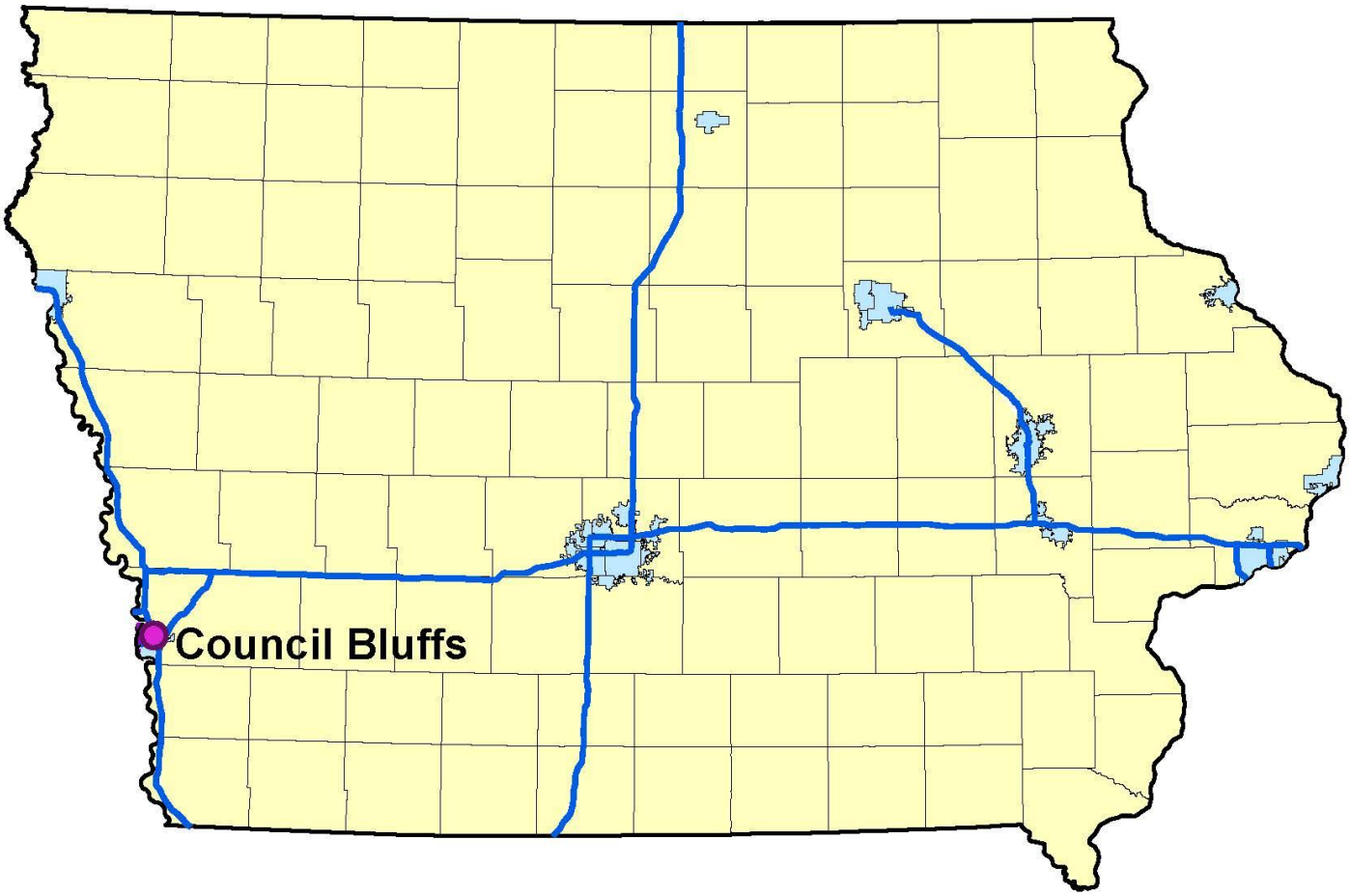
Additional details on the manganese sampling conducted in Iowa during 2012 are indicated below.

Definitions

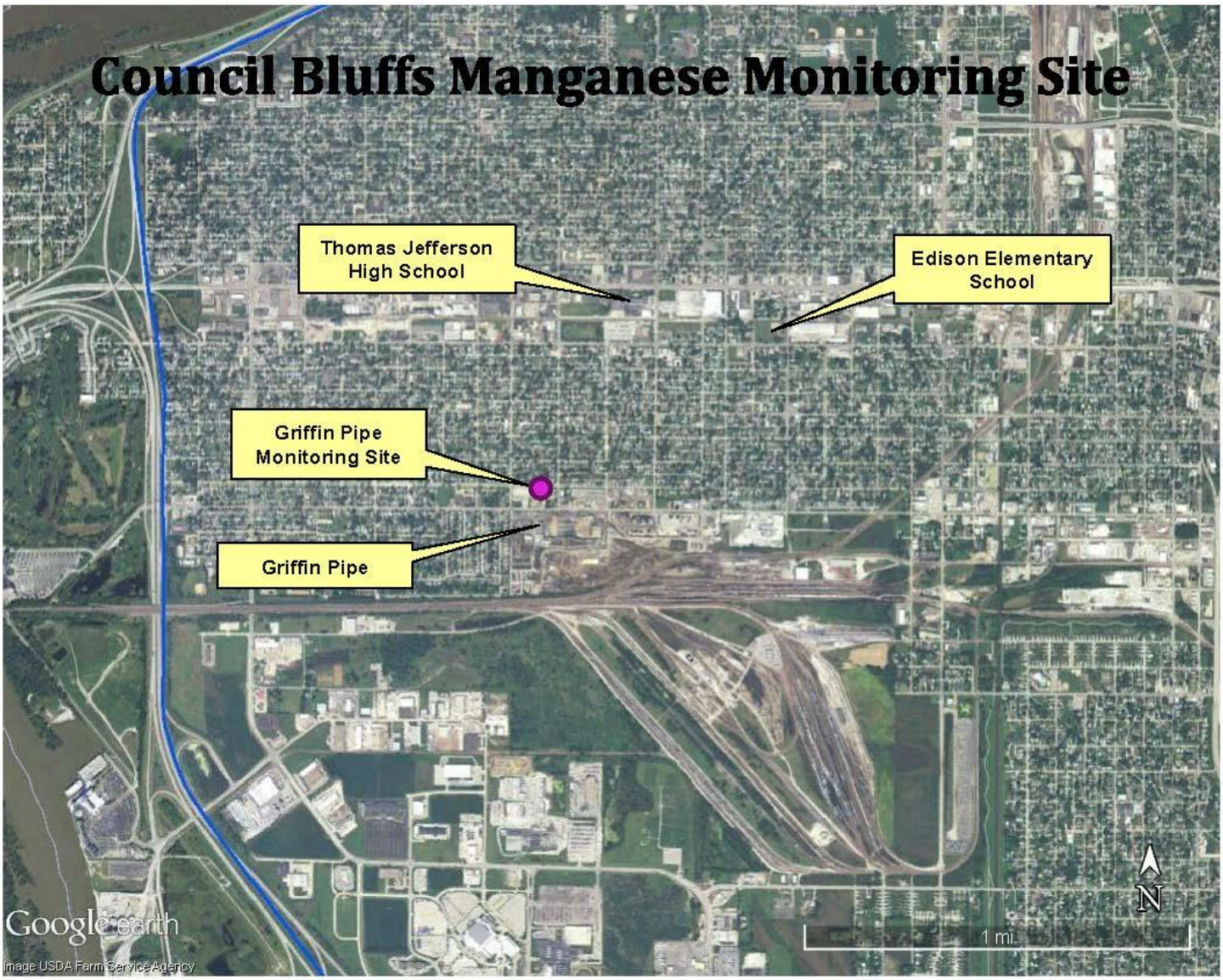
- *Data Capture*. The data capture rate is defined as the ratio of the number of samples taken (including scheduled and valid substitute samples) divided by the number of scheduled samples in each calendar quarter. EPA data analysis guidelines usually require 75% data completeness across each sampling quarter.
- *Precision Data*. Precision data are reported for the total number of collocated pairs of samples collected. Precision statistics shown in this report have been calculated according to 40 CFR Part 58, Appendix A (2006) using the methodology applicable to collocated fine particulate data pairs. (See Appendix B. Precision Calculations)

[1] USA Today: "The Smokestack Effect; Toxic Air and America's Schools" (Accessed 8/9/13)
[2] Quality Assurance Project Plan For the EPA School Air Toxics Monitoring Program (Accessed 8/9/13)
[3] Iowa DNR 2011 Manganese Report (Accessed 8/9/13)
[4] EPA Lead Nonattainment Areas (Accessed 8/9/13)

Manganese Monitoring Network – 2012



Site ID	Site Label	City	Address	County
191550011	Council Bluffs, Griffin Pipe	Council Bluffs	8th Avenue and 27th	Pottawattamie



Concentration Summary (ng/m^3)

Site / Pollutant	Council Bluffs, Griffin Pipe
Manganese	95 (±16)

The value indicated is the average concentration measured in 2012.
The value in parentheses represents the variance in concentration as calculated from the 95% Confidence Interval for the mean.

2011-2012 Manganese Concentration Summary Chart

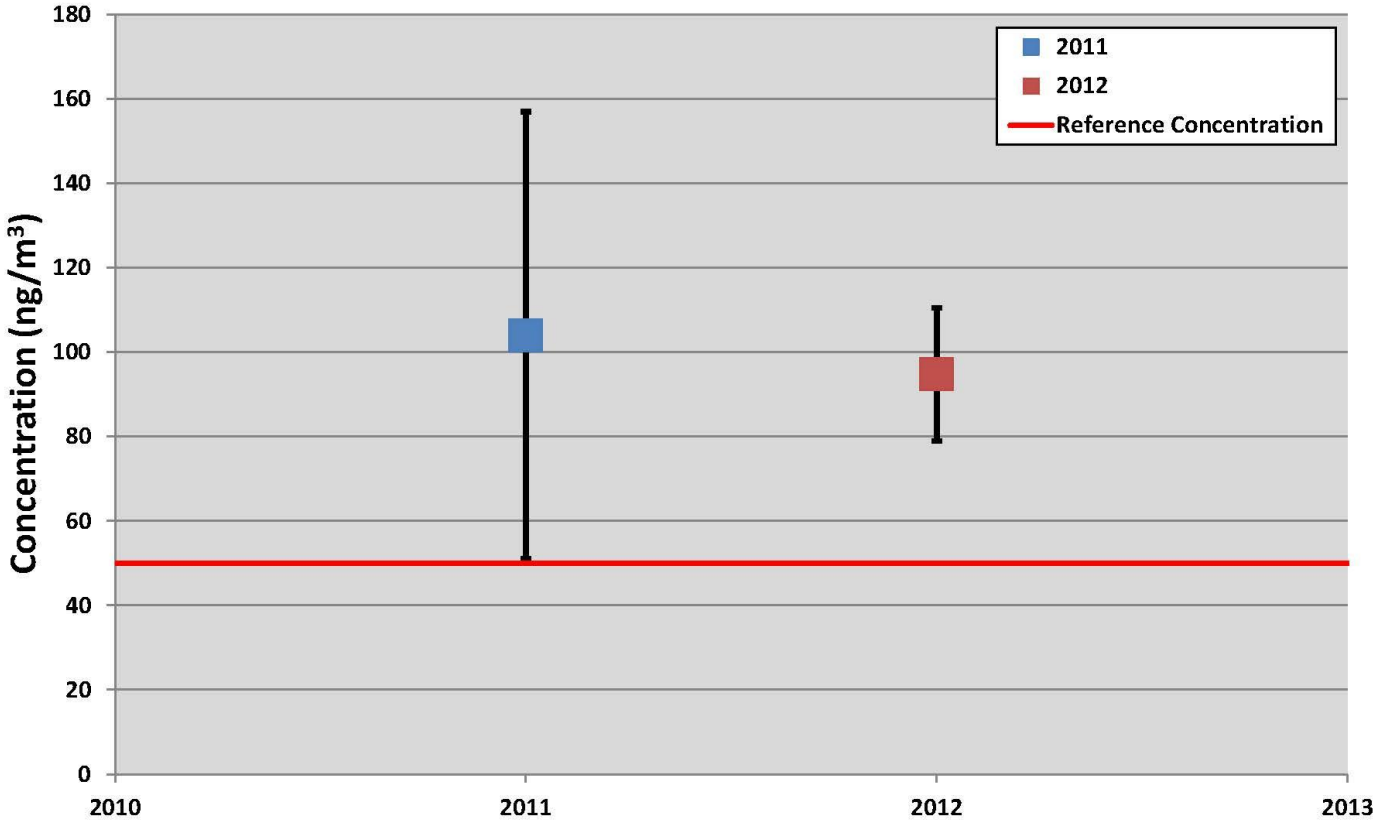


Chart depicting the average concentration of airborne manganese for each year & the uncertainty. Longer error bars mean greater uncertainty. The error bars are much shorter for 2012 which implies less uncertainty in the annual average.

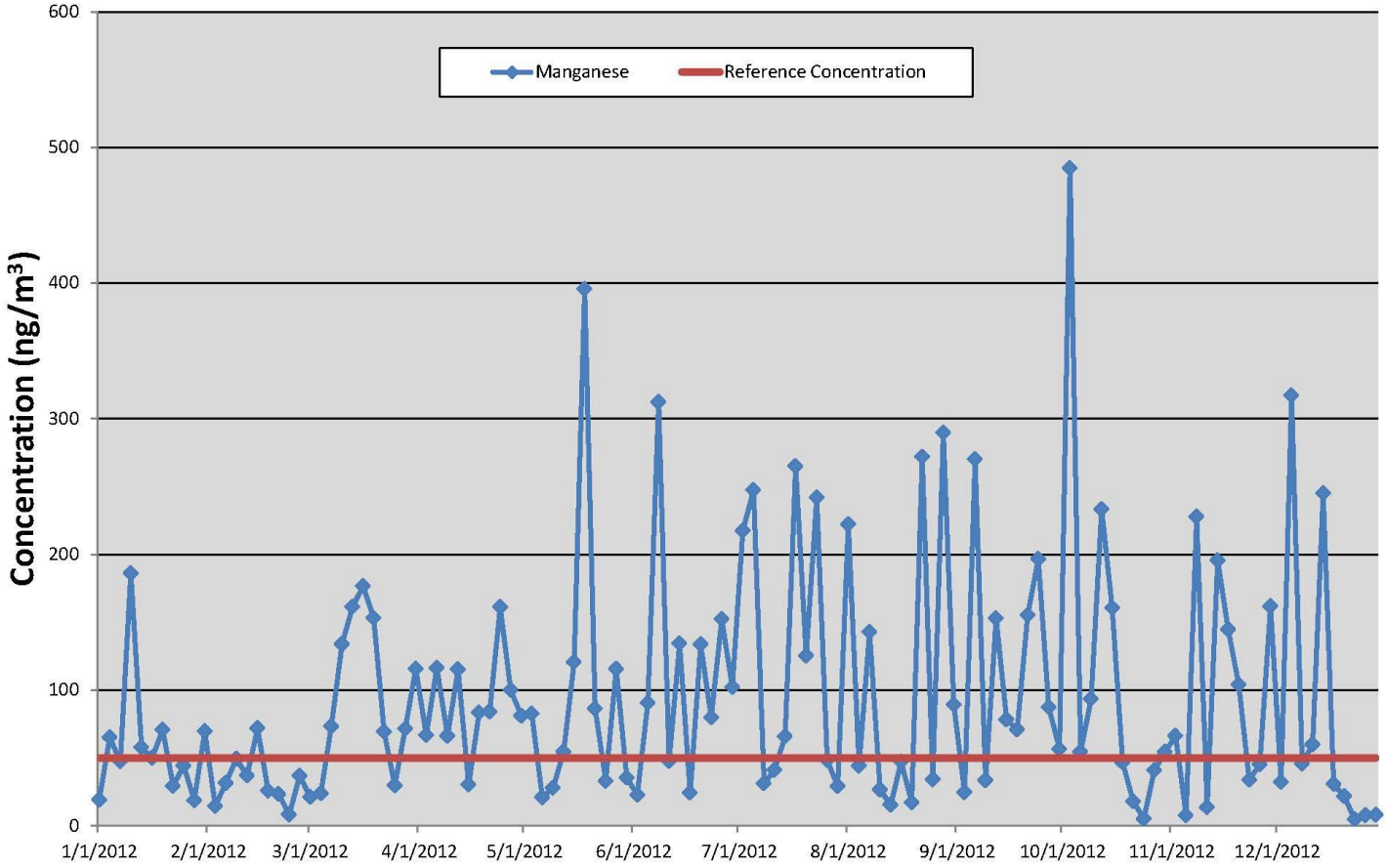
2012 Percent Manganese Data Capture

Council Bluffs, Griffin Pipe
100%

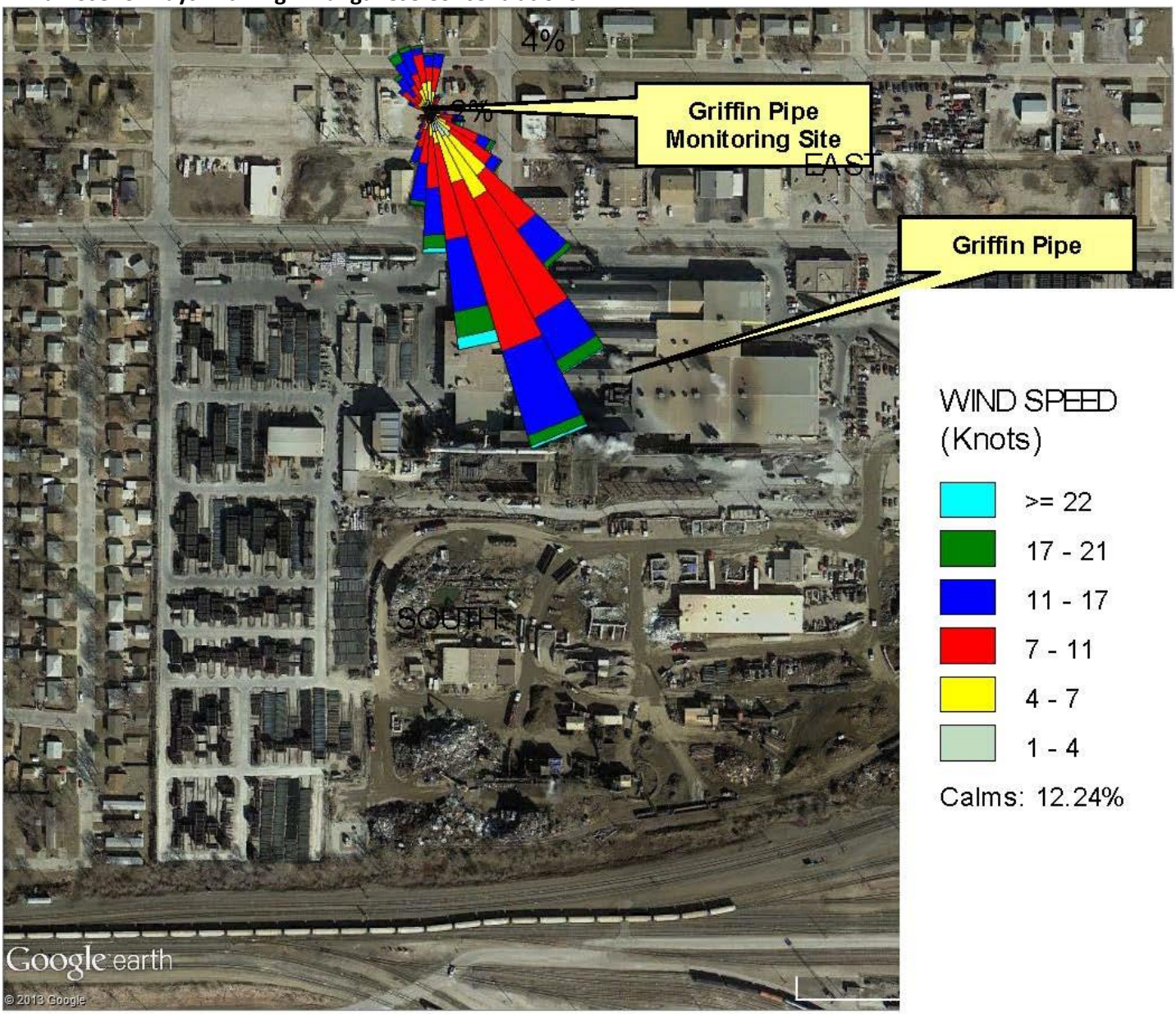
2012 Annual Manganese Precision Statistics

Number of Pairs	Upper 90% Confidence Limit
60	11.6%

Manganese Levels Recorded in 2012 at the Griffin Pipe Monitoring Site in Council Bluffs



Wind Rose for Days with High Manganese Concentrations



Wind rose depicting primary wind directions and speeds on days where average manganese concentrations were at or above the EPA reference concentration of 50 ng/m3. The rose shows winds to be primarily southeasterly on days when these high levels occurred. A comparison of these winds, the yearly wind rose and a summary of how the roses are calculated can be found in Appendix C. Wind Rose Explanation & Comparison of Wind Data.

Wind Rose for Days with Low Manganese Concentrations

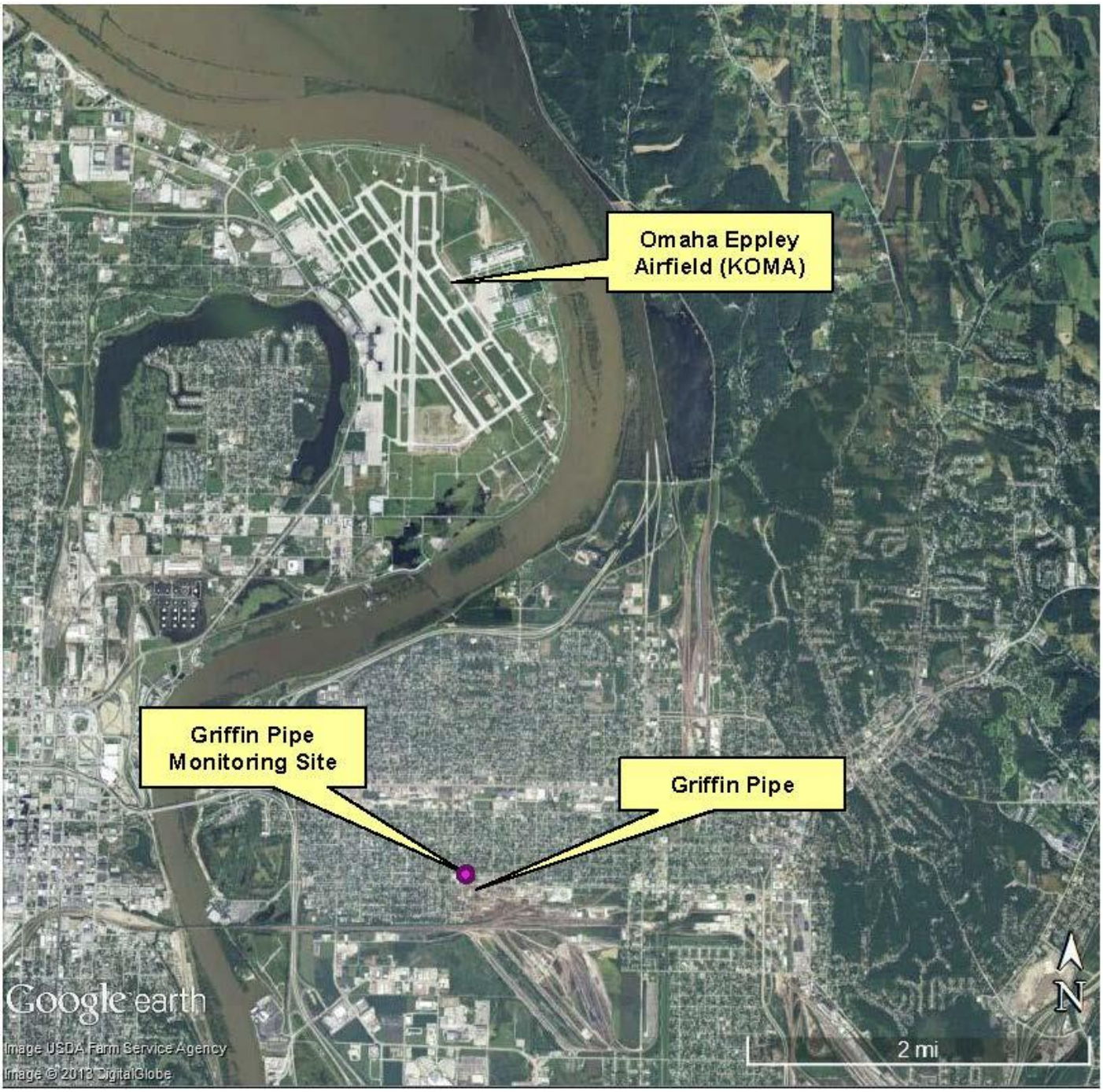
Wind rose depicting primary wind directions and speeds on days where manganese concentrations remained below the EPA reference concentration of 50 ng/m3. The rose shows winds to be primarily north & northwesterly on days when average concentrations remain below 50 ng/m3. A comparison of these winds, the yearly wind rose and a summary of how the roses are calculated can be found in Appendix C. Wind Rose Explanation & Comparison of Wind Data.

Manganese Raw Data 2012–Council Bluffs

Date	Mn (ng/m^3)	Date	Mn (ng/m^3)	Date	Mn (ng/m^3)
1/1/2012	19.17	5/3/2012	82.49	9/3/2012	24.49
1/4/2012	64.94	5/6/2012	20.95	9/6/2012	270.09
1/7/2012	47.24	5/9/2012	27.81	9/9/2012	33.43
1/10/2012	186.01	5/12/2012	54.28	9/12/2012	152.8
1/13/2012	57.62	5/15/2012	120.48	9/15/2012	78.12
1/16/2012	49.93	5/18/2012	395.52	9/18/2012	70.77
1/19/2012	70.63	5/21/2012	86.21	9/21/2012	155.37
1/22/2012	29.36	5/24/2012	32.86	9/24/2012	196.61
1/25/2012	44.14	5/27/2012	115.56	9/27/2012	87.25
1/28/2012	18.65	5/30/2012	35.3	9/30/2012	56.48
1/31/2012	69.48	6/2/2012	22.64	10/3/2012	484.54
2/3/2012	14.52	6/5/2012	90.21	10/6/2012	54.37
2/6/2012	31.39	6/8/2012	312.31	10/9/2012	93.2
2/9/2012	49.22	6/11/2012	47.74	10/12/2012	233.19
2/12/2012	36.95	6/14/2012	134.23	10/15/2012	160.48
2/15/2012	71.75	6/17/2012	24.19	10/18/2012	46.36
2/18/2012	25.6	6/20/2012	133.61	10/21/2012	17.89
2/21/2012	23.24	6/23/2012	79.64	10/24/2012	4.99
2/24/2012	8.11	6/26/2012	152.27	10/27/2012	40.74
2/27/2012	36.73	6/29/2012	102.07	10/30/2012	54.27
3/1/2012	21	7/2/2012	217.4	11/2/2012	66.22
3/4/2012	23.67	7/5/2012	247.24	11/5/2012	7.53
3/7/2012	73.23	7/8/2012	31.07	11/8/2012	227.7
3/10/2012	133.87	7/11/2012	40.96	11/11/2012	13.49
3/13/2012	161.38	7/14/2012	65.88	11/14/2012	195.5
3/16/2012	176.56	7/17/2012	264.98	11/17/2012	144.49
3/19/2012	153.2	7/20/2012	125.14	11/20/2012	103.87
3/22/2012	69.1	7/23/2012	241.87	11/23/2012	33.79
3/25/2012	29.52	7/26/2012	48.31	11/26/2012	45.04
3/28/2012	71.39	7/29/2012	29.02	11/29/2012	161.64
3/31/2012	115.7	8/1/2012	222.1	12/2/2012	32.16
4/3/2012	66.63	8/4/2012	44.16	12/5/2012	317.2
4/6/2012	116.26	8/7/2012	142.76	12/8/2012	45.61
4/9/2012	66.1	8/10/2012	26.51	12/11/2012	59.86
4/12/2012	115.14	8/13/2012	15.19	12/14/2012	245.06
4/15/2012	30.15	8/16/2012	47.07	12/17/2012	30.54
4/18/2012	83.33	8/19/2012	17	12/20/2012	21.53
4/21/2012	83.96	8/22/2012	271.81	12/23/2012	4.65
4/24/2012	161.09	8/25/2012	34.15	12/26/2012	7.74
4/27/2012	99.95	8/28/2012	289.58	12/29/2012	7.88
4/30/2012	81.02	8/31/2012	89.19		

Appendix A. Council Bluffs Monitoring Locations

Manganese data in this report was obtained from the Griffin Pipe Monitoring site located approximately 200 yards northwest of the main stack of the Griffin Pipe Products Facility in Council Bluffs, Iowa. Meteorological data was collected at the KOMA Automated Weather Observing system (AWOS) site at the Eppley Airfield in Omaha, Nebraska. KOMA is approximately 3 miles NNW of the Griffin Pipe monitoring site.



Appendix B. Precision Calculations

Let c_i^1 and c_i^2 represent two concentrations from a particular monitoring location taken on the same day. If both are greater than the MDL, then they may be used to estimate the precision of the data at the sampling location as follows:

First compute the average:

$$\overline{c_i} = \frac{c_i^1 + c_i^2}{2}$$

And the mean difference:

$$d_i = \frac{c_i^1 - c_i^2}{c_i} \times 100$$

Finally, compute the upper confidence limit in the usual way (See: 4.2.1 of 40 CFR Part 58, Appendix A):

$$Upper\ 90\%\ Confidence\ Limit\ of\ CV = \frac{s}{\sqrt{2}} \times \sqrt{\frac{n-1}{X^{-1}(0.90, n-1)}}$$

Where *s* is the sample standard deviation of the mean difference (d_i), and X^{-1} represents the inverse of the chi-squared distribution.

Appendix C. Wind Rose Explanation & Comparison of Wind Data

The wind rose is a graphical representation of the frequency of a wind from a given direction at a given location. The longer the petal, the more frequently that location experienced winds from that direction.

The colors represent the percentage of time the winds are at a given speed from a direction. Calm winds are not shown on the wind rose. They are denoted at the bottom of the color legend to the right of a wind rose plot.

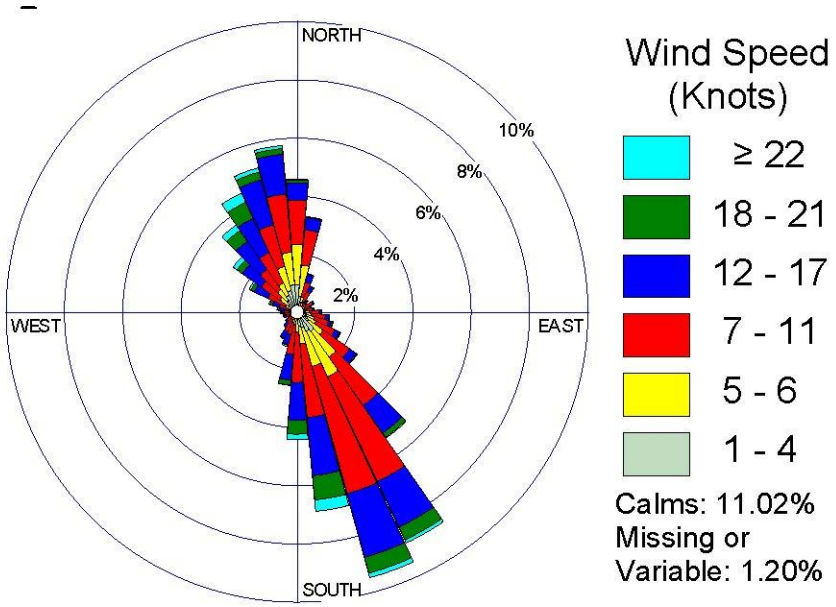


Figure 1: Yearly wind rose from the Omaha Eppley Airfield (KOMA) Automated Surface observing System (ASOS). Prevalent wind directions for the entire year range from the north & northwesterly along with south & southeasterly.

Wind data selected for this report consisted of all 2012 quality- controlled observations from the nearest Automated Surface Observing System (ASOS) site. The observations are stored on the National Climatic Data Center (NCDC) servers for download. Listed wind speeds are given in knots.

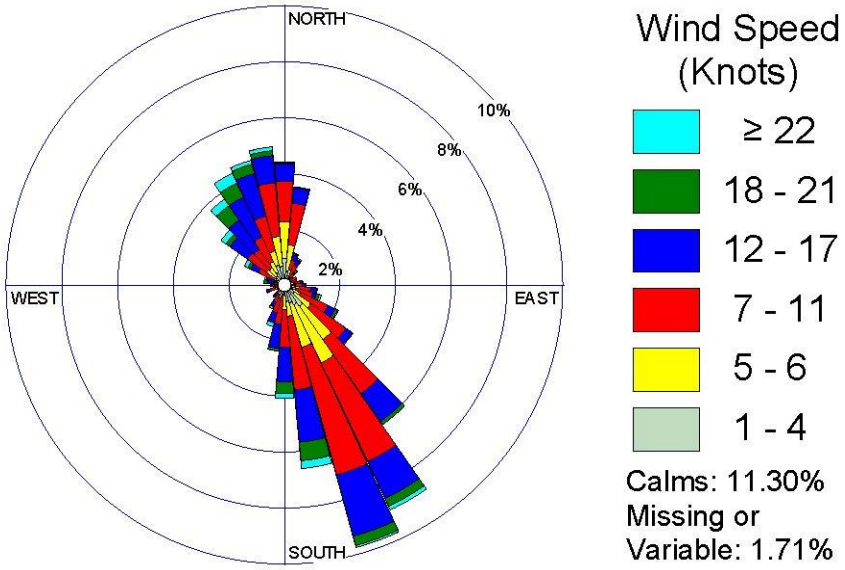


Figure 2: Wind rose from KOMA ASOS on days when manganese sampling occurred. The outputted rose is very similar to the rose representing an entire year's worth of wind data. This suggests that winds on sampling days are representative of and comparable to the whole year's wind data.

Data for the year 2012 was fed into a program that sorted through the dataset and selected the wind reading that was associated with the standard hourly observation time. Special observations were ignored because they may not be representative of the given time period. If winds were variable in direction they were also excluded from the data set.

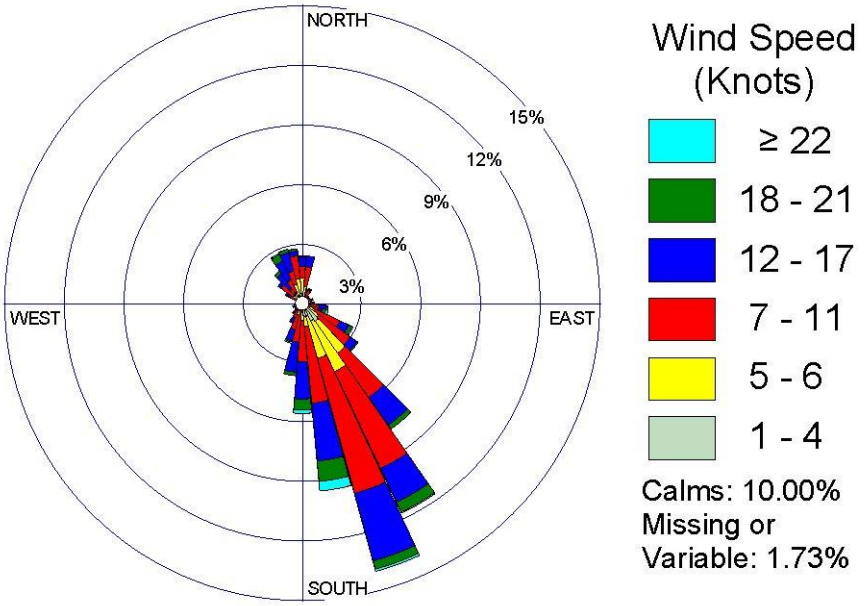


Figure 3: Wind rose from KOMA ASOS on days with high concentrations of manganese. Winds out of the south & southeast are dominant in this diagram which suggests the source is southeast of the monitor.

Figure 1 represents the yearly wind rose from the ASOS site at Omaha Eppley Airfield (KOMA). The wind rose shows that the majority of the winds are from the north, northwest, south and southeast. Most of the wind speeds in a given year are less than twelve (12) miles per hour.

Figure 2 represents the wind rose on days where manganese sampling occurred. Data for the wind direction, speed distribution, number of calm winds and missing data are similar to the entire set for 2012. This suggests that the wind data on days where manganese sampling occurred is likely to be representative of the winds throughout 2012.

Figure 3 represents the wind rose on days where the EPA reference concentration for manganese was exceeded. Over 65% of all recorded non-calm, non-variable and non- missing winds had directions out of the south & southeast on days where concentrations greater than 50 ng/m3 were recorded. This data suggests that the source of the airborne manganese lies to the south and southeast of the monitor.

Figure 4 shows a wind rose on days where manganese concentrations were 50 ng/m3 or less. In this diagram winds are more prevalent out of the north and northwest. It is important to note that Figures 1 through 4 represent all hourly winds recorded on manganese sampling days. If the wind switches directions during the course of the day with an elevated manganese concentration, it is not possible to determine if the elevated levels originate from sources in one or both directions.

The majority of the petals representative of southerly and southeasterly winds were recorded on days with manganese concentrations above 50 ng/m3. The majority of petals from the north and northwest where recorded on days with manganese concentrations of 50 ng/m3 or less. These observations suggest that sources to the north, west and east are not responsible for elevated manganese concentrations.

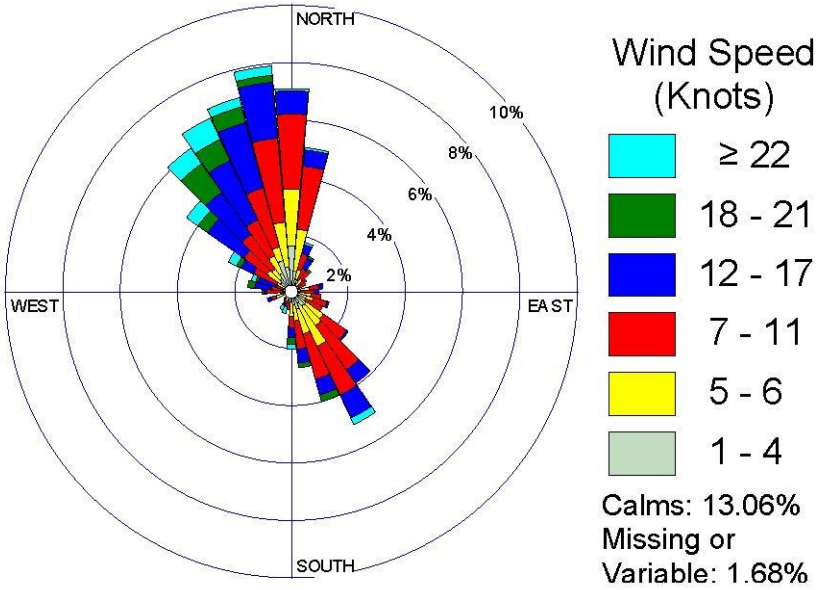


Figure 4: Wind rose showing wind directions & speeds on days when observed manganese concentrations were 50 ng/m3 or less.